

CLAIMS:

1. A method for applying wear reducing material to a tool joint useful in a wellbore in drilling operations, the method comprising

positioning the tool joint adjacent laser beam apparatus,

delivering wear-reducing material to a location on the tool joint to which the wear-reducing material is to be applied, the wear-reducing material having a melting temperature, and

heating the wear-reducing material with the laser beam apparatus to a temperature not exceeding the melting temperature of the wear-reducing material thereby welding the wear-reducing material to the tool joint.

2. The method of claim 1 wherein the wear-reducing material is heated with a laser beam that is defocused so that the melting temperature of the wear-reducing material is not exceeded.

3. The method of claim 1 wherein the tool joint is made of tool joint material and the wear-reducing material is heated with a laser beam that is defocused so that the tool joint material is not melted.

4. The method of claim 1 wherein the wear-reducing material is applied in a pattern of intermittent spaced-apart areas of wear-reducing material.

5. The method of claim 4 wherein the intermittent spaced-apart areas of wear reducing material provide fluid flow paths therebetween for enhancing fluid flow past the tool joint when it is within a wellbore.

6. The method of claim 1 further comprising

applying the wear-reducing material to the tool joint so that cracks are formed in the wear-reducing material for reducing stress in the applied wear-reducing material.

7. The method of claim 1 wherein the laser beam apparatus is defocused so that no plasma is formed adjacent the tool joint.

1 8. The method of claim 1 wherein the wear-reducing material
2 is applied with a substantially uniform thickness to the tool
3 joint.

1 9. The method of claim 9 wherein the thickness varies
2 between ± 0.020 inches.

1 10. The method of claim 1 wherein a metallurgical bond is
2 formed between the wear-reducing material and the tool joint.

1 11. The method of claim 1 wherein the wear-reducing material
2 includes carbides.

1 12. The method of claim 2 wherein the carbides are in a
2 matrix of wear resistant material

1 13. The method of claim 1 wherein the tool joint is made of
2 base metal and there is less than 5% dilution of the base metal by
3 the applied wear-reducing material.

1 14. The method of claim 1 wherein the tool joint is made of
2 base metal and there is less than 2% dilution of the base metal by
3 the applied wear-reducing material.

1 15. The method of claim 1 wherein the wear-reducing material
is combined with friction reducing material.

1 16. The method of claim 1 wherein the wear-reducing material
is from the group consisting of carbides, borides, silicides, and
2 nitrides.

1 17. The method of claim 1 wherein the wear-reducing material
is alloyed with an alloying element from the group consisting of
2 chromium, manganese, molybdenum, vanadium, boron, carbon, aluminum,
3 titanium, zirconium, tantalum, sulfur, silicon, phosphorus,
4 bismuth, cerium, praseodymium, neodymium, promethium, samarium,
5 europium, gadolinium, terbium, dysprosium, holmium, erbium,
6 thulium, ytterbium, and lutetium.

1 18. A method for applying wear reducing material to a tool
2 joint useful in a wellbore in drilling operations, the method
3 comprising

4 positioning the tool joint adjacent laser beam
5 apparatus,

6 delivering wear-reducing material to a location on
7 the tool joint to which the wear-reducing material is to be
8 applied, the wear-reducing material having a melting
9 temperature,

10 heating the wear-reducing material with the laser
11 beam apparatus to a temperature not exceeding the melting
12 temperature of the wear-reducing material thereby welding the
13 wear-reducing material to the tool joint,

14 wherein the laser beam apparatus is defocused so
15 that no plasma is formed adjacent the tool joint,

16 wherein the wear-reducing material is applied with
17 a substantially uniform thickness to the tool joint,

18 wherein a metallurgical bond is formed between the
19 wear-reducing material and the tool joint,

20 wherein the wear-reducing material includes
21 carbides,

22 wherein the carbides are in a matrix of wear
23 resistant material, and

24 wherein the tool joint is made of base metal and
25 there is less than 5% dilution of the base metal by the
26 applied wear-reducing material.

1 19. A tool joint to which wear-reducing material has been
2 applied by a method for applying wear-reducing material, the method
3 comprising positioning the tool joint adjacent laser beam
4 apparatus, delivering wear-reducing material to a location on the
5 tool joint to which the wear-reducing material is to be applied,
6 the wear-reducing material having a melting temperature, and
7 heating the wear-reducing material with the laser beam apparatus to
8 a temperature not exceeding the melting temperature of the wear-
9 reducing material thereby welding the wear-reducing material to the
10 tool joint.

1 20. A method for applying wear reducing material to a tool
2 joint useful in a wellbore in drilling operations, the method
3 comprising

4 positioning the tool joint adjacent laser beam
5 apparatus,

6 delivering wear-reducing material to a location on
7 the tool joint to which the wear-reducing material is to be
8 applied, and

9 heating the wear-reducing material with a defocused
10 laser beam of the laser beam apparatus thereby welding the
11 wear-reducing material to the tool joint.

12 21. Any patentable invention disclosed herein.